

## Claims

- [c1] An apparatus for marking a biopsy site, comprising:  
a marker having a trailing end and a leading end;  
an attachment means of straight configuration having a trailing end embedded within said marker and a leading end disposed in leading relation to said leading end of said marker;  
a delivery catheter having an anvil means fixedly secured within a lumen of said delivery catheter at a leading end of said delivery catheter;  
said anvil having a cavity means formed therein that causes bending of said attachment means into a hook shape when said attachment means is driven into said cavity.
- [c2] The apparatus of claim 1, wherein said attachment means is a metal wire.
- [c3] The apparatus of claim 1, wherein said attachment means is formed of biologically absorbable materials.
- [c4] The tissue marker means of claim 1, wherein said marker is formed of biologically absorbable materials.
- [c5] A method for positioning a tissue marker means at a tissue site, comprising the steps of:  
fixedly securing a trailing end of a straight attachment means into a leading end of a tissue marker means;  
providing a delivery catheter having a side port and means for communicating a vacuum to a lumen of said delivery catheter;  
fixedly securing an anvil means within said lumen of said delivery catheter at a leading end of said delivery catheter, in leading relation to said side port;  
forming a blind bore having a concave bottom in said anvil;  
introducing said tissue marker means into said lumen of said delivery catheter from a trailing end of said delivery catheter;  
introducing said delivery catheter into a biopsy needle having a side port so that the respective side ports of the delivery catheter and biopsy needle are in substantial registration with one another;  
applying a vacuum to said biopsy needle so that tissue is pulled into the lumen

of said delivery catheter;  
 pushing said tissue marker means toward said leading end of said delivery catheter so that said straight attachment means passes through tissue that has been pulled under vacuum into the lumen of said delivery catheter and then enters into said blind bore where a leading distal end of said straight attachment means is bent into a hook shape when said leading end encounters said concave bottom;  
 removing said biopsy needle and delivery catheter from said tissue site so that only said marker and said attachment means remain at said site, said hook-shaped leading end of said attachment means engaging said tissue and preventing migration of said marker and of said attachment means.

[c6]

An apparatus for anchoring a tissue marker to a tissue site, comprising:  
 a tissue marker of generally cylindrical configuration;  
 a first bore formed in said tissue marker in coincidence with a longitudinal axis of symmetry of said tissue marker, said first bore extending from a trailing end to a leading end of said tissue marker;  
 an annular cavity formed in a leading end of said tissue marker in concentric relation to said bore;  
 a clip having opposed jaws disposed in a normally closed configuration where respective free ends of said jaws are in close juxtaposition with one another; said clip having a base formed in a trailing end of said clip, said base received within and fixedly secured to said annular cavity;  
 a second bore formed in said clip in coincidence with a longitudinal axis of symmetry of said clip, said second bore being in axial alignment with said first bore when said base of said clip is received within said annular cavity of said tissue marker;  
 a plunger having a first part of generally cylindrical configuration, said first part having a diameter substantially equal to a diameter of said tissue marker so that said first part and said tissue marker are adapted to be slideably received within a delivery catheter;  
 said plunger having a reduced diameter second part with a pointed leading end for penetrating tissue;

said second part having an elongate extent sufficient to extend sequentially through said first bore formed in said tissue marker, said second bore formed in said clip, and between said opposed jaws, said pointed leading end of said second part being disposed in leading relation to a leading end of said jaws when said plunger is fully introduced into said delivery catheter; whereby said second part causes said opposed jaws to diverge from one another when inserted therebetween; and whereby said opposed jaws converge toward one another under said inherent bias when said second part of said plunger is withdrawn.

- [c7] The apparatus of claim 6, wherein said clip is formed of a metallic material.
- [c8] The apparatus of claim 6, wherein said clip is injection molded.
- [c9] The apparatus of claim 6, wherein said clip is formed of biologically absorbable materials.
- [c10] The apparatus of claim 6, wherein said marker is formed of biologically absorbable materials.
- [c11] A method for anchoring a tissue marker to a tissue site, comprising:  
 providing a tissue marker of generally cylindrical configuration;  
 forming a first bore in said tissue marker in coincidence with a longitudinal axis of symmetry of said tissue marker so that said first bore extends from a trailing end to a leading end of said tissue marker;  
 forming an annular cavity in a leading end of said tissue marker in concentric relation to said bore;  
 providing a clip having opposed jaws disposed in a normally closed configuration where respective free ends of said jaws are in close juxtaposition with one another;  
 forming a base in a trailing end of said clip so that said base is received within and fixedly secured to said annular cavity;  
 forming a second bore in said clip in coincidence with a longitudinal axis of symmetry of said clip so that said second bore is in axial alignment with said first bore when said base of said clip is received within said annular cavity of

said tissue marker;  
 providing a plunger having a first part of generally cylindrical configuration,  
 said first part having a diameter substantially equal to a diameter of said tissue  
 marker so that said first part and said tissue marker are adapted to be slideably  
 received within a delivery catheter;  
 providing said plunger with a reduced diameter second part with a pointed  
 leading end for penetrating tissue;  
 forming said second part to have an elongate extent sufficient to extend  
 sequentially through said first bore formed in said tissue marker, said second  
 bore formed in said clip, and between said opposed jaws so that said pointed  
 leading end of said second part is disposed in leading relation to a leading end  
 of said jaws when said plunger is fully introduced into said delivery catheter;  
 said second part causing said opposed jaws to diverge from one another when  
 inserted therebetween; and  
 said opposed jaws converging toward one another under said inherent bias,  
 thereby capturing tissue therebetween, when said second part of said plunger is  
 withdrawn.

[c12]

An apparatus for anchoring a tissue marker to a tissue site, comprising:  
 a marker of generally cylindrical configuration having a leading end and a  
 trailing end;  
 a first bore formed in said trailing end of said marker in coincidence with a  
 longitudinal axis of symmetry of said marker;  
 a second bore formed in said leading end of said marker in coincidence with a  
 longitudinal axis of symmetry of said marker;  
 said first and second bores being in open communication with one another and  
 said second bore having a diameter greater than a diameter of said first bore;  
 a clip having a trailing end and a leading end, said trailing end adapted to be  
 received within said second bore;  
 said clip having first and second opposed jaws disposed in normally open,  
 parallel relation to one another;  
 a third bore formed in said trailing end of said clip in coincidence with a  
 longitudinal axis of symmetry of said clip, said third bore being cross-shaped in

transverse cross-section;

an inner plunger having a leading end having a circular transverse cross-section of predetermined extent and a pointed distal end of predetermined extent that is adapted to penetrate tissue, said pointed distal end being formed integrally with said leading end and being positioned in leading relation thereto;

said inner plunger having a trailing end having a circular transverse cross-section;

said inner plunger having a middle part having a cross-shaped transverse cross-section adapted to be slidingly received within said cross-shaped third bore, said middle part being formed integrally with said leading and trailing ends of said plunger and being disposed therebetween;

an outer plunger having a central bore adapted to slidingly receive said trailing end of said inner plunger;

said outer plunger having a leading end adapted to abuttingly engage said trailing end of said marker;

a first radially outwardly extending protuberance formed on a first jaw of said clip and a second radially outwardly extending protuberance formed on a second jaw of said clip;

said first protuberance having a first beveled trailing surface and said second protuberance having a second beveled trailing surface;

said first and second opposed jaws being driven toward one another when said marker is driven in a trailing to leading direction by said outer plunger, said leading end of said marker slideably engaging said first and second trailing beveled surfaces and driving said first and second trailing beveled surfaces toward one another;

said middle part of said inner plunger being positioned on a trailing side of said third bore and said middle part being rotationally misaligned with said cross-shaped third bore so that a trailing end of said middle part is disposed in abutting relation to a leading end of said third bore, thereby preventing travel of said clip in a trailing-to-leading direction when said inner plunger is held against movement in said trailing-to-leading direction;

whereby said inner plunger is held against movement in said trailing-to-leading direction, thereby holding said clip against movement in said trailing-to-



of:

forming a marker of generally cylindrical configuration so that it has a leading end and a trailing end;

forming a first bore in said trailing end of said marker in coincidence with a longitudinal axis of symmetry of said marker;

forming a second bore in said leading end of said marker in coincidence with a longitudinal axis of symmetry of said marker;

forming said first and second bores so that they are in open communication with one another and so that said second bore has a diameter greater than a diameter of said first bore;

providing a clip having a trailing end and a leading end, and adapting said trailing end so that it is received within said second bore formed in said leading end of said marker;

said clip having a pair of opposed jaws adapted to engage tissue therebetween;

forming a third bore in said trailing end of said clip marker in coincidence with a longitudinal axis of symmetry of said clip and forming said third bore so that it is cross-shaped in transverse cross-section;

providing an inner plunger having a leading end with a circular transverse cross-section of predetermined extent and a pointed distal end of predetermined extent that is adapted to penetrate tissue, said pointed distal end being formed integrally with said leading end and being positioned in leading relation thereto;

providing said inner plunger with a trailing end having a circular transverse cross-section;

providing said inner plunger with a middle part having a cross-shaped transverse cross-section that is adapted to be slidingly received within said cross-shaped third bore;

forming an outer plunger with a central bore adapted to slidingly receive said trailing end of said inner plunger;

providing said outer plunger with a leading end adapted to abuttingly engage said trailing end of said marker;

forming a first radially-outwardly extending protuberance on a first jaw of said clip and forming a second radially-outwardly extending protuberance on a

second jaw of said clip;  
forming a first beveled trailing surface on a trailing side of said first protuberance and forming a second beveled trailing surface on a trailing side of said second protuberance;  
driving said first and second opposed jaws toward one another by driving said marker in a trailing-to-leading direction with said outer plunger so that said leading end of said marker slideably engages said first and second beveled trailing surfaces and drives said first and second beveled trailing surfaces toward one another;  
said middle part of said inner plunger being positioned on a trailing side of said third bore and said middle part being rotationally misaligned with said cross-shaped third bore so that a trailing end of said middle part is disposed in abutting relation to a leading end of said third bore;  
whereby said inner plunger is held against movement in a longitudinal direction, thereby holding said clip against movement in said longitudinal direction, and said outer plunger is displaced in a trailing-to-leading direction to drive said marker and said clip in said trailing-to-leading direction, said marker leading end entering into sliding engagement with said first and second beveled surfaces, driving them into converging relation with one another;  
whereby respective leading ends of said opposed jaws are driven into tissue by continued trailing-to-leading displacement of said outer plunger;  
whereby when said jaws are fully embedded within said tissue, a part of said tissue is captured between said jaws;  
whereby longitudinal displacement of said inner plunger in a trailing-to-leading direction and rotation of said inner plunger about its longitudinal axis of symmetry until said middle part aligns with the cross-shaped cross section of said third bore, followed by retraction of said inner plunger in a leading-to-trailing direction until said inner plunger has exited said first bore leaves said clip secured to said tissue and said marker secured to said trailing end of said clip.

[c19]

The method of claim 18, further comprising the step of forming an annular bevel in said leading end of said marker to facilitate sliding engagement of said



leading end of said marker and said first and second beveled trailing surfaces formed in said first and second protuberances, respectively.

[c20]

An apparatus for anchoring a tissue marker to a tissue site, comprising:

- a marker having an elongate cylindrical structure;
- a cross-shaped bore formed in said marker by a first slot that intersects with a second slot, said first slot having a greater radial extent than said second slot;
- a clip having opposed jaws that are disposed in parallel relation to one another when in a position of repose;
- said clip having a base fixedly secured to said marker;
- a cross-shaped bore formed in said base of said clip by a first slot that intersects with a second slot, said first slot having a greater radial extent than said second slot;
- said bore formed in said marker and said bore formed in said base of said clip being in axial alignment with one another;
- first and second laterally-outwardly projecting, external wings formed in said first and second jaws, respectively;
- first and second laterally-inwardly projecting, internal wings formed in said first and second jaws, respectively;
- a beveled trailing surface formed in each of said internal wings;
- said first and second external wings being diametrically opposed to one another and said first and second internal wings being diametrically opposed to one another;
- said first and second external wings having a swept back configuration to facilitate their entry into tissue;
- a plunger having a pointed leading end and a cross-shaped transverse cross section that corresponds to the respective shapes of said slots formed in said marker;
- said plunger being sequentially inserted into said bore formed in said marker and said bore formed in said trailing end of said clip so that said pointed distal end of said plunger is introduced into a space between said opposed jaws;
- said plunger bearing against said beveled trailing surfaces formed in said internal wings and thereby causing said opposed jaws to diverge from one

another;

whereby retracting said plunger so that it disengages from said slots formed in said clip, followed by rotating said plunger ninety degrees to align the cross-shaped transverse cross section of the plunger with said slots, and sequentially pulling said plunger out of said clip and marker enables said opposed jaws to close under an inherent bias, said jaws capturing tissue therebetween when so closed;

whereby said internal wings serve to engage said tissue and work in conjunction with said external wings to prevent retraction of said clip from said tissue; and whereby said first and second external wings prevent reverse migration of said clip after said clip has penetrated said tissue.

[c21] The apparatus of claim 20, wherein said clip is formed of a metallic material.

[c22] The apparatus of claim 20, wherein said clip is injection molded.

[c23] The apparatus of claim 20, wherein said clip is formed of biologically absorbable materials.

[c24] The apparatus of claim 20, wherein said marker is formed of a biologically absorbable material.

[c25] A method for anchoring a tissue marker to a tissue site, comprising the steps of:  
 providing a marker having an elongate cylindrical structure;  
 forming a cross-shaped bore in said marker by forming a first slot that intersects with a second slot, said first slot having a greater radial extent than said second slot;  
 providing a clip having opposed jaws that are disposed in parallel relation to one another when in a position of repose;  
 fixedly securing a base of said clip to said marker;  
 forming a cross-shaped bore in said base of said clip by forming a first slot that intersects with a second slot, said first slot having a greater radial extent than said second slot;  
 positioning said bore formed in said marker and said bore formed in said base

of said clip so that said bores are in axial alignment with one another;  
forming first and second laterally-outwardly projecting external wings in said first and second jaws, respectively, and forming first and second laterally-inwardly projecting internal wings in said first and second jaws, respectively; each of said internal wings having a bevel formed in a trailing surface thereof; positioning said first and second external wings in diametrically opposed relation to one another and positioning said first and second internal wings in diametrically opposed relation to one another;  
forming said first and second external wings so that they have a swept back configuration to facilitate their entry into tissue;  
providing a plunger having a pointed leading end and a cross-shaped transverse cross-section that corresponds to the respective shapes of said slots formed in said marker, said cross-shaped transverse cross-section forming protuberances that extend radially outwardly;  
sequentially inserting said plunger into said bore formed in said marker and said bore formed in said trailing end of said clip so that said pointed distal end of said plunger is introduced into a space between said opposed jaws; whereby said protuberances bear respectively against said trailing surfaces formed in said internal wings and thereby cause said opposed jaws to diverge from one another;  
whereby retracting said plunger so that it disengages from said slots formed in said clip, followed by rotating said plunger ninety degrees to align the radially extending protuberances of said plunger with said slots, and sequentially pulling said plunger out of said clip and marker enables said opposed jaws to close under an inherent bias, said jaws capturing tissue therebetween when so closed;  
whereby said trailing surfaces serve to engage said tissue and work in conjunction with said external wings to prevent retraction of said clip from said tissue; and  
whereby said first and second external wings prevent reverse migration of said clip after said clip has penetrated said tissue.

[c26]

An apparatus for anchoring a tissue marker to a tissue site, comprising:

a clip having a main body, a base formed on a trailing end of said main body,  
 and a pair of opposed jaws formed on a leading end of said main body;  
 a marker having a blind cylindrical bore formed in a leading end thereof;  
 said base being received within said blind cylindrical bore;  
 said base being fixedly secured within said blind cylindrical bore;  
 said pair of opposed jaws being disposed in substantially parallel relation to one  
 another when in repose;  
 a first pair of recesses formed in a leading end of said clip main body in  
 diametrically opposed relation to one another;  
 a second pair of recesses formed in a trailing end of said main body of said clip  
 in diametrically opposed relation to one another;  
 a pair of diametrically opposed raised areas formed in said main body between  
 said leading and trailing ends;  
 a pair of diametrically opposed recesses formed in said main body in  
 interconnecting relation between respective trailing ends of said first pair of  
 recesses and said respective raised parts;  
 a delivery catheter adapted to ensleeved said marker and said clip;  
 a cylindrical sleeve adapted to ensleeve said delivery catheter;  
 a pair of diametrically opposed, radially inwardly extending pins formed in said  
 cylindrical sleeve;  
 a first opening formed in said delivery catheter to accommodate a first pin and  
 a second opening formed in said delivery catheter in diametric opposition to  
 said first opening to accommodate a second pin of said pair of pins;  
 a leading end of said delivery catheter and a leading end of said cylindrical  
 sleeve being in substantial alignment with one another and said opposed jaws  
 being in repose when said cylindrical sleeve is positioned in ensleeving relation  
 to said delivery catheter;  
 positioning a plunger within a lumen of said delivery catheter in trailing relation  
 to said marker;  
 whereby advancing the plunger in a trailing-to-leading direction causes said  
 marker to drive said clip in the same direction and causes said opposed jaws to  
 be driven toward one another because said pins are constrained to slide up said  
 beveled surfaces from said first and second recesses respectively onto said

raised surfaces and said pins are constrained against radial outward travel by said cylindrical sleeve and because said pins cannot be displaced in a radially outward direction they drive said opposed jaws toward one another; whereby the respective distal free ends of said jaws firmly grasp tissue therebetween, permanently anchoring said clip to said tissue; and whereby continued pushing of said marker by said plunger drives said pins from said raised surfaces into said second pair of recesses, thereby releasing pressure from said pins and enabling withdrawal of said delivery catheter and cylindrical sleeve.

[c27] The apparatus of claim 26, wherein said clip is formed of a metallic material.

[c28] The apparatus of claim 26, wherein said clip is injection molded.

[c29] The apparatus of claim 26, wherein said clip is formed of biologically absorbable materials.

[c30] The apparatus of claim 26, wherein said marker is formed of biologically absorbable materials.

[c31]

A method for anchoring a tissue marker to a tissue site, comprising the steps of:

- providing a clip having a main body, a base formed on a trailing end of said main body, and a pair of opposed jaws formed on a leading end of said main body;
- providing a marker having a blind cylindrical bore formed in a leading end thereof;
- positioning said base within said blind cylindrical bore;
- fixedly securing said base within said blind cylindrical bore;
- positioning said pair of opposed jaws in a position of repose where said jaws are in substantially parallel relation to one another;
- forming a first pair of recesses in a leading end of said clip main body in diametrically opposed relation to one another;
- forming a second pair of recesses in a trailing end of said main body of said clip in diametrically opposed relation to one another;

forming a pair of diametrically opposed raised areas in said main body between said leading and trailing ends;  
 forming a pair of diametrically opposed recesses in said main body in interconnecting relation between respective trailing ends of said first pair of recesses and said respective raised parts;  
 providing a delivery catheter adapted to ensleeve said marker and said clip;  
 providing a cylindrical sleeve adapted to ensleeve said delivery catheter;  
 forming a pair of diametrically opposed, radially inwardly extending pins in said cylindrical sleeve;  
 forming a first opening in said delivery catheter to accommodate a first pin and forming a second opening in said delivery catheter in diametric opposition to said first opening to accommodate a second pin of said pair of pins;  
 positioning a leading end of said delivery catheter and a leading end of said cylindrical sleeve in substantial alignment with one another so that said opposed jaws are in repose when said cylindrical sleeve is positioned in ensleeving relation to said delivery catheter;  
 positioning a plunger within a lumen of said delivery catheter in trailing relation to said marker;  
 advancing the plunger in a trailing-to-leading direction to cause said marker to drive said clip in the same direction and to cause said opposed jaws to be driven toward one another because said pins are constrained to slide up said beveled surfaces from said first and second recesses respectively onto said raised surfaces and said pins are constrained against radial outward travel by said cylindrical sleeve and because said pins cannot be displaced in a radially outward direction they drive said opposed jaws toward one another;  
 continuing to push said marker in said direction by said plunger to drive said pins from said raised surfaces into said second pair of recesses, thereby releasing pressure from said pins and enabling withdrawal of said delivery catheter and cylindrical sleeve;  
 whereby respective distal free ends of said jaws firmly grasp tissue therebetween, permanently anchoring said clip to said tissue.

[c32]

An apparatus for anchoring a tissue marker to a tissue site, comprising:

a core biopsy needle having a side port near a leading end thereof;  
a delivery catheter having a side port near a leading end thereof;  
said delivery catheter being slideably disposed within a lumen of said core biopsy needle, said side port of said delivery catheter being in substantial juxtaposition with said side port of said core biopsy needle;  
a ramp member disposed at a leading end of said delivery catheter, said ramp member including an arcuate curved surface formed in a trailing end thereof;  
a marker disposed in a lumen of said delivery catheter;  
an attachment means having a trailing end secured to said marker and a leading end disposed in leading relation to said marker;  
a barb means for engaging tissue formed in said leading end of said attachment means;  
a plunger disposed in said lumen of said delivery catheter in trailing relation to said marker, said plunger adapted to push said marker into said ramp member so that said attachment means is pushed through said delivery catheter side port and said core biopsy needle side port so that said barb means formed in said leading end of said attachment means is embedded within tissue that surrounds said core biopsy needle;  
whereby said marker is secured to said tissue and said barb maintains said marker against migration in the absence of a vacuum means for pulling tissue into said core biopsy needle or said delivery catheter.

- [c33] The apparatus of claim 32, wherein said attachment means is formed of a metallic material.
- [c34] The apparatus of claim 32, wherein said attachment means is injection molded.
- [c35] The apparatus of claim 34, wherein said attachment means is formed of biologically absorbable materials.
- [c36] The apparatus of claim 34, wherein said marker is formed of biologically absorbable materials.
- [c37] A method for anchoring a tissue marker to a tissue site, comprising the steps of:

providing a core biopsy needle having a side port near a leading end thereof;  
providing a delivery catheter having a side port near a leading end thereof;  
slideably disposing said delivery catheter within a lumen of said core biopsy  
needle so that said side port of said delivery catheter is in substantial  
juxtaposition with said side port of said core biopsy needle;  
positioning a ramp member at a leading end of said delivery catheter and  
forming in a trailing end of said ramp member an arcuate curved surface;  
positioning a marker in a lumen of said delivery catheter;  
securing a trailing end of an attachment means to a leading end of said marker  
so that a leading end of said attachment means is disposed in leading relation  
to said marker;  
forming a barb means for engaging tissue in said leading end of said  
attachment means;  
positioning a plunger in said lumen of said delivery catheter in trailing relation  
to said marker;  
pushing said marker into said ramp member with said plunger so that said  
attachment means is pushed through said delivery catheter side port and said  
core biopsy needle side port and so that said barb means formed in said leading  
end of said attachment means is embedded within tissue that surrounds said  
core biopsy needle;  
whereby said marker is secured to said tissue and said barb maintains said  
marker against migration in the absence of a vacuum means for pulling tissue  
into said core biopsy needle or said delivery catheter.

[c38]

An apparatus for anchoring a tissue marker to a tissue site, comprising:  
a coaxial needle having a trailing end and a leading end;  
a marker positioned within a lumen of said coaxial needle;  
a plunger positioned within a lumen of said coaxial needle in trailing relation to  
said marker so that advancing said plunger in a trailing-to-leading direction  
pushes said marker toward said leading end of said coaxial needle and out of  
said leading end into a biopsy tract;  
an attachment means having a trailing end secured to said marker and a leading  
end adapted to engage tissue;





attachment means of a flexible and resilient material and folding said attachment means into an undeployed configuration when said marker is disposed within said lumen of said coaxial needle so that said attachment means unfolds and is deployed under its inherent bias when said marker is fully pushed out of said lumen.